Technical notes

The flavour hiding in different marc varieties

Flavour comes in many different forms and not all of them are obvious. While monoterpenes are known to contribute 'floral' or 'citrus' characters that are important to young white wines, in grapes and juice these compounds are largely bound to sugars as odourless glycosides. To provide flavour in wine, the monoterpene glycosides must be broken down to release the odour-active portion, which can happen in one of two ways:

- during winemaking or storage, through the action of enzymes from yeast or bacteria and through the acidic nature of wine
- in-mouth during tasting by the microflora present in the mouth.

Flavour can also end up in winemaking by-products. For example, the grape marc generated during white winemaking contains a significant quantity of monoterpene glycosides, and this pool of flavour precursors is generally not further utilised. This has led to research exploring grape marc extracts as a potential source of flavour additives for wine.

Flavour evolution when adding marc extracts to wine at different pH

We have previously added marc-derived extracts that are rich in monoterpene glycosides to wines boost 'floral' aroma over the course of six months of storage. In this experiment a Riesling wine (pH 3.1) and a Chardonnay wine (pH 3.4) were supplemented with an extract of Gewürztraminer marc. The wines were then monitored over three years of storage to understand how the flavour evolved under different pH conditions.

The breakdown of geraniol glucoside, one of the major monoterpene glycosides in these marc extracts, occurred much more quickly in the lower-pH Riesling wine than in the Chardonnay wine (Figure 1). However, for the resultant formation of odour-active monoterpenes, faster formation also saw more rapid disappearance. In the higher-pH Chardonnay wine, the floral monoterpenes geraniol and linalool peaked after approximately 18 months of storage but were already declining after 6 months in the lower-pH Riesling wine. A balance may therefore be required between speed of release and lifespan of the desired flavour.

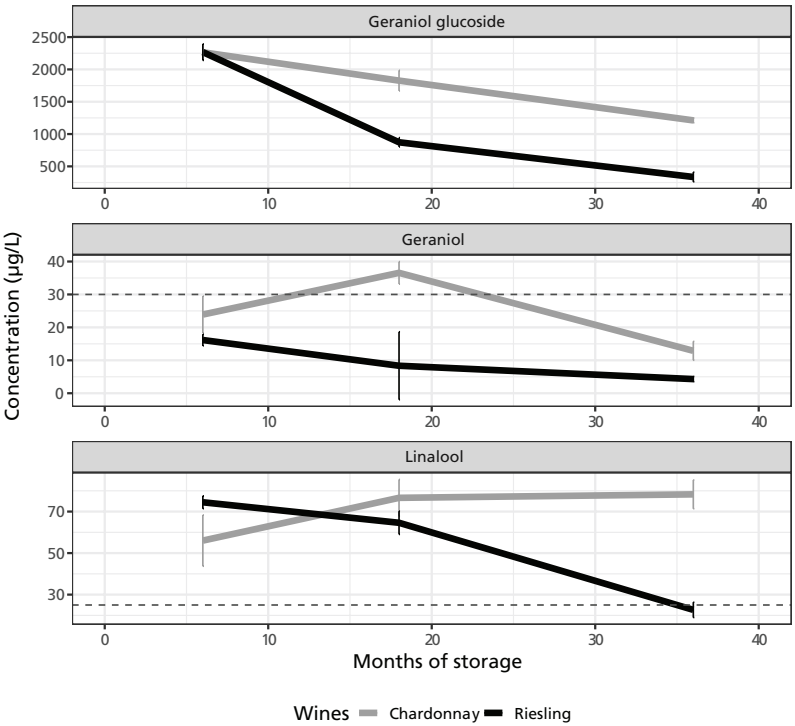

Figure 1. Chemical composition of Riesling (black line) and Chardonnay wines (grey line) over 36 months post-bottling following addition of glycoside extract from Gewürztraminer marc. Top pane: slow breakdown of geraniol glucoside. Middle and bottom panes: release and then disappearance of volatile monoterpenes, geraniol and linalool, often associated with young white wines.

Choosing the grape marc

The experiment described above used a single extract of Gewürztraminer marc. Given that grape marc is commonly aggregated of a range of varieties, an experiment was conducted to examine the impact of the variety on the flavour profile generated from addition of the marc extract. Several varietally distinct grape parcels were obtained and pressed, providing a collection of marc samples from both 'floral' and 'non-floral' varieties from which extracts were prepared.

The marc extracts were added to a commercial Chardonnay wine which was stored in bottle for six months before undergoing chemical and sensory analysis. As expected, the extracts derived from 'floral' varieties contained a significantly higher concentration of monoterpene glycosides, and this translated to a greater evolution of volatile monoterpenes after six months of storage (Figure 2). In addition, the two extracts derived from Muscat varieties (Muscat Gordo Blanco and Muscat à petits grains blancs, [Muscat aPGB])

gave much higher concentrations of monoterpenes than the other floral varieties, including the original Gewürztraminer extract ('2016 Gewürztraminer') that was used in the earlier experiment. The non-floral varieties yielded a significantly lower concentration of volatiles (note the different scale used between the left and right panes of Figure 2), and most were only slightly higher in monoterpenes than the control wine with no added marc extract. Additionally, the addition of non-floral varieties resulted in a higher proportion of norisoprenoids, a class of compounds responsible for characters such as 'stewed apple', 'violet' or 'kerosene'.

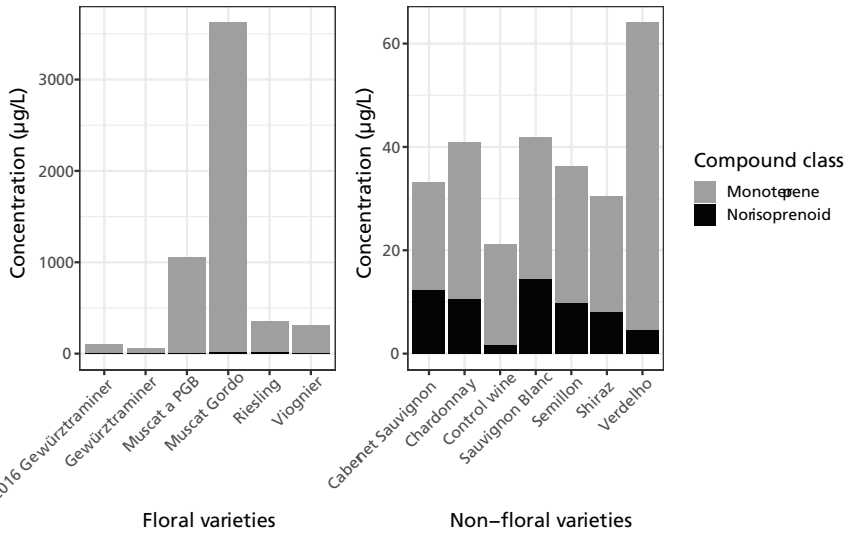

Figure 2. Concentration of Chardonnay wines after six months of storage in bottle with added marc extract from different varieties, showing compound classes monoterpenes (grey) and norisoprenoids (black). Left pane: varieties deemed 'floral'. Right pane: varieties deemed 'non-floral'.

The wines underwent sensory analysis by a rapid profiling method, where an experienced panel placed them on a two-dimensional space based on perceived similarities or differences (Figure 3). There was a clear separation of the wines based on variety of extract added, with the 'floral' varieties generally situated in the lower half of Figure 3, separated from the two red varieties to the upper right of the figure, while Chardonnay and Semillon were grouped towards the upper left. Riesling was situated closer to the non-floral varieties.

The wines with added Muscat or Gewürztraminer extracts were described as 'citrus', 'stone fruit', 'rose' or 'floral'. The wine with added Riesling extract was not described as 'floral', but was indicated to have a 'citrus' aroma, while the wines with Shiraz and Cabernet Sauvignon

extracts were indicated as 'red fruit' ('raspberry', 'cherry') as well as pink in colour. The wines with added Chardonnay and Semillon extracts were neutral in flavour compared to the other varieties. The wine with Verdelho was described as more 'tropical fruit' and 'stone fruit'. These descriptors, perhaps not surprisingly, reflect some of the varietal characters observed in conventional winemaking with these varieties.

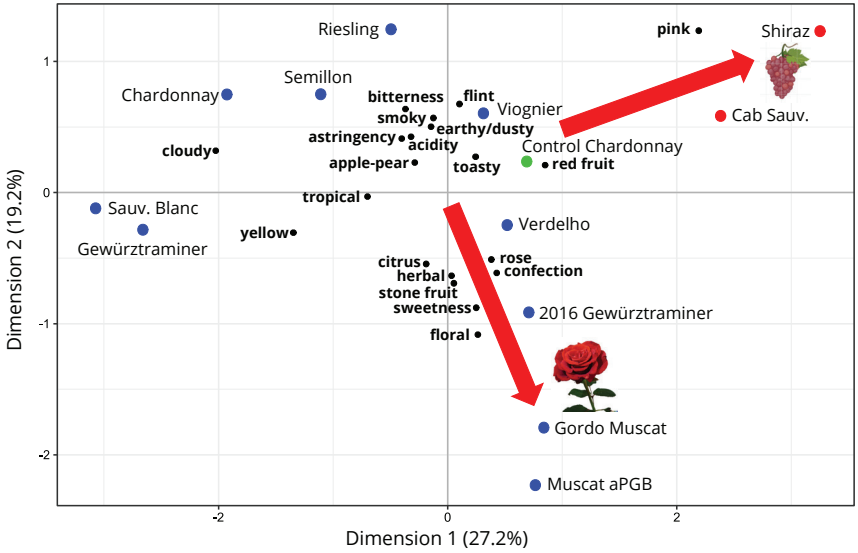

Figure 3. A map of the sensory differences among the wines generated through addition of marc extracts derived from different varieties to a base Chardonnay wine. Arrows indicate the most notable distinctions between wines.

While the extraction process used to generate the extracts was developed to remove bitter grape phenolics, and generally the wines were low in bitterness and astringency, the wine with the Semillon extract was described as notably bitter by the panel.

Conclusions

While the volatile profiles from all the floral variety extracts were similar, there were distinct differences in the magnitude of flavour generated. The grape variety of the marc clearly has a strong effect on the flavour nuances found in a wine with added marc-derived flavour.

There are logistical implications for wineries considering using marc extracts as a flavour booster, both in terms of how to source sufficient quantities of the requisite grape marc and the costs of extraction. Any aggregation point for grape marc in wineries has historically involved varietal mixing in a single marc heap. It may be practical for some facilities to keep Muscat marc separate from other varieties.

Future directions

Understanding flavour formation from non-volatile precursors also provides insights into wine shelf-life in terms of the speed at which flavours develop and then diminish, as well as for the evolution of smoke taint. Addition of glycoside-rich extracts may be useful in new product development, specifically in no- and low- alcohol products where the flavour profile needs supplementing. In the immediate future, the production of glycoside-rich extracts will require further optimisation, to minimise cost and energy requirements. However, it is nonetheless conceivable that grape marc-derived flavour additives could become akin to tannin additives in the near future.

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